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# **The Influence of El Nino southern oscillation (ENSO) on the summer monsoon precipitation in Myanmar**

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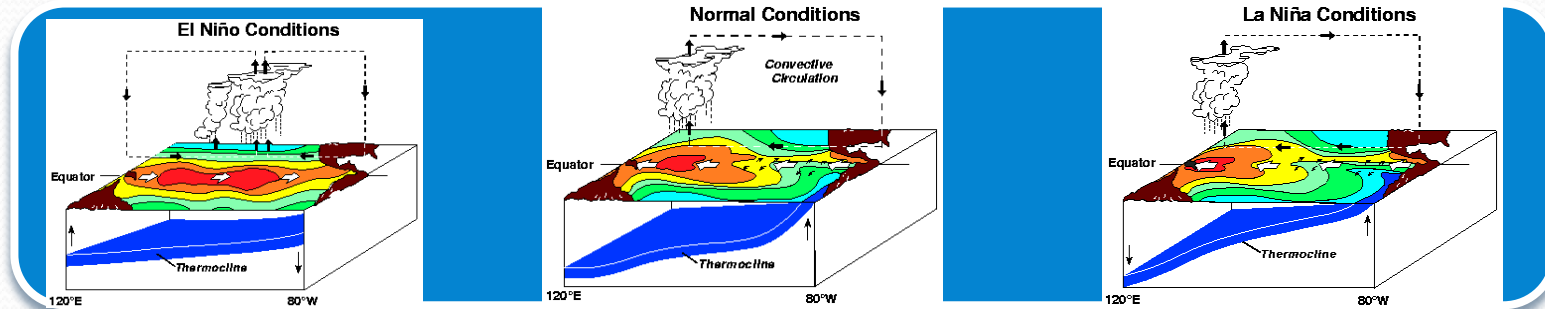


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# 1.Introduction

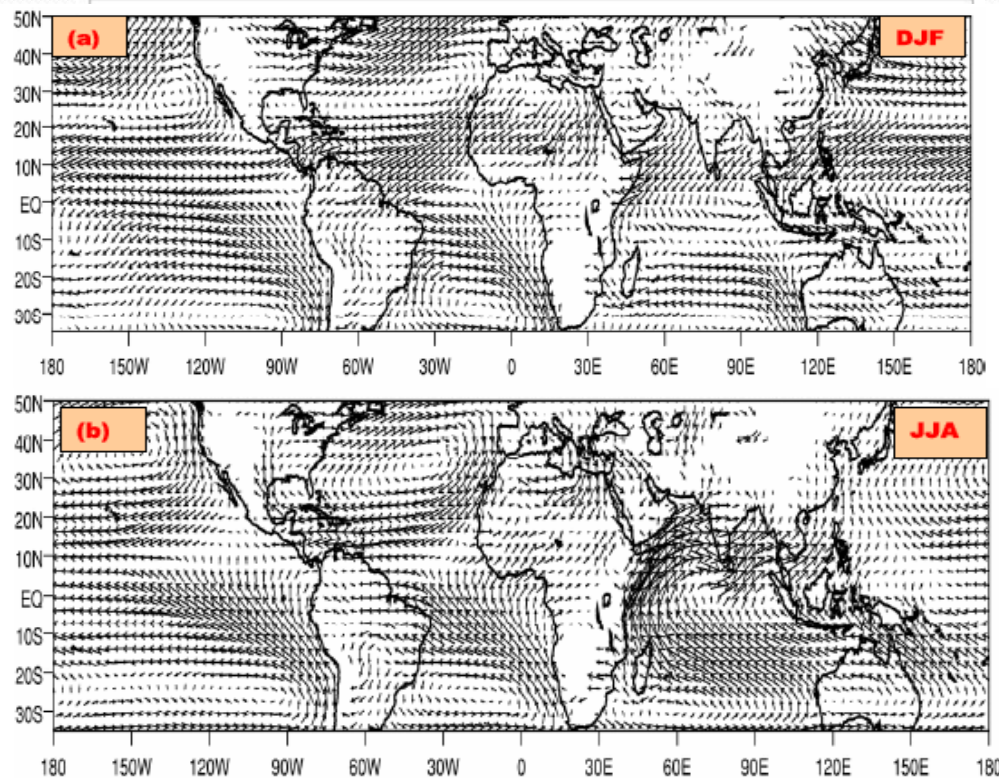
- One of the most widely researched global teleconnections index is in the form of El Niño Southern oscillation (ENSO).

- ENSO is broadly defined as a disruption in ocean surface temperature in the Pacific Ocean. There is an increased frequency of warm episodes of ENSO, which affect the precipitation regimes in the tropic and sub- tropic.



# 1.Introduction

- Myanmar is located in the northwestern part of the Indochina Peninsula, between Latitude  $09^{\circ} 32'N$  and  $28^{\circ} 31'N$  and Longitude  $92^{\circ}10' E$  and  $101^{\circ}11'E$ .



The most important feature in the climate of Myanmar is the alternations of seasons known as monsoon which normally starts in mid-May and lasts until mid-October. The wind during the northern winter season is northeasterly or easterly at the 850hPa level (Fig 3.a) and the southwest or westerly wind in the summer monsoon season (Fig 3.b)

Fig 3. Climatological DJF 850 hpa wind and JJA 850 hpa wind . (After Goswami , 2004)

## 2. Previous Studies: ENSO AND MONSOON

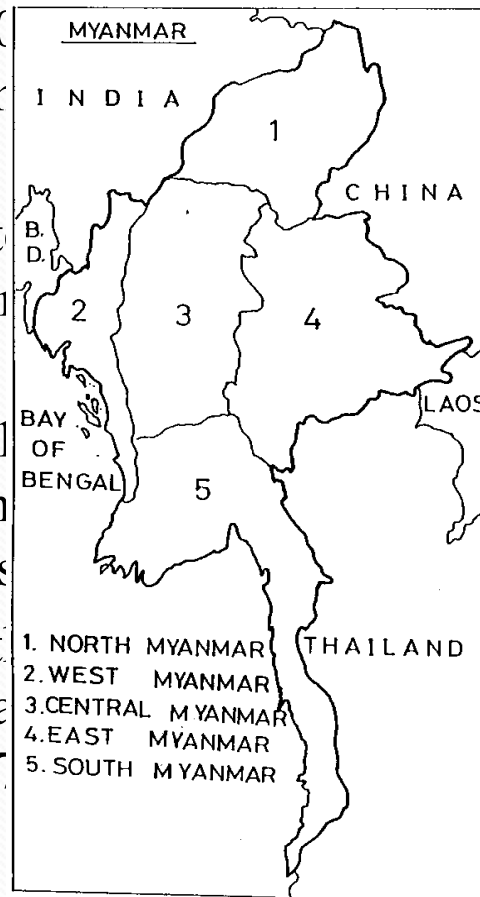
- The relationship between warm phase of ENSO and below average summer monsoon precipitation over the Indian subcontinent has been investigated in several previous research studies (Sikka and Gadgil, 1980; Rasmusson and Carpenter, 1982)

Mooley and Parthasarthy (1984) found that the deficient India summer Monsoon rainfall tends to occur in the year when an El Nino event develops

In general, not many studies exist on Myanmar's climatology.

## 2. Previous studies

- N.Sen Roy and kaur (2000) studied the monsoon climatology of Myanmar, the result of the study is that the monsoon precipitation regions .
- Their study also indicated that during the period 1947-1997, the monsoon rainfall below 10% average sum of the monsoon has been investigated.
- During the period 1947-1997, the monsoon excess rainfall have been investigated and the relationship with the sea surface temperature (SST) and El Niño/Southern Oscillation (ENSO) has been studied.
- Lwin (2000) found that the monsoon rainfall as annual temperatures, and the monsoon rainfall starting from the mid 1970s has been investigated.
- There is still a need how the monsoon rainfall in Myanmar after 1970 and the influence of ENSO on developing and decaying phase.
- In view of the importance of the monsoon climatology and relation with ENSO mechanisms, this study will examined the physical impact from El Niño/ La Niña to Myanmar climatological monsoon system.



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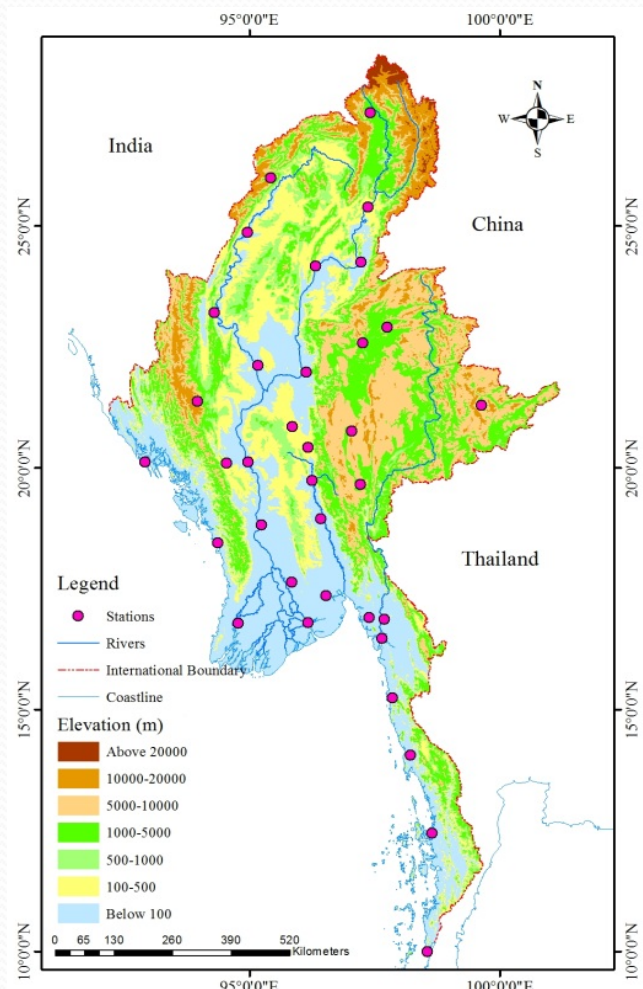
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### 3.Data and Methodology

- Daily precipitation data.
- Methodology



Rainfall is an essential meteorological parameter describing the monsoon climate.

Daily precipitation data were obtained from Department of Metrology and Hydrology (DMH) of Myanmar for the 30 year

#### Methodology

The cluster analysis based on Ward's method was applied for the seasonal variation patterns of daily mean precipitation data.

Data comprises monthly rainfall amounts for June to September. Seasonal rainfall percentage departures for entire southwest monsoon have also been worked out.

Figure 5. Topography ( shading ) of Myanmar and the 35 observation stations ( red dots).

# Objective

- The main purpose of this study is to clarify the regional difference of rainfall pattern in Myanmar.
- To reveal the impact of El Niño / La Niña to Myanmar.

## I. Cluster analysis





# Analysis: The climatology of monsoon rainfall in Myanmar

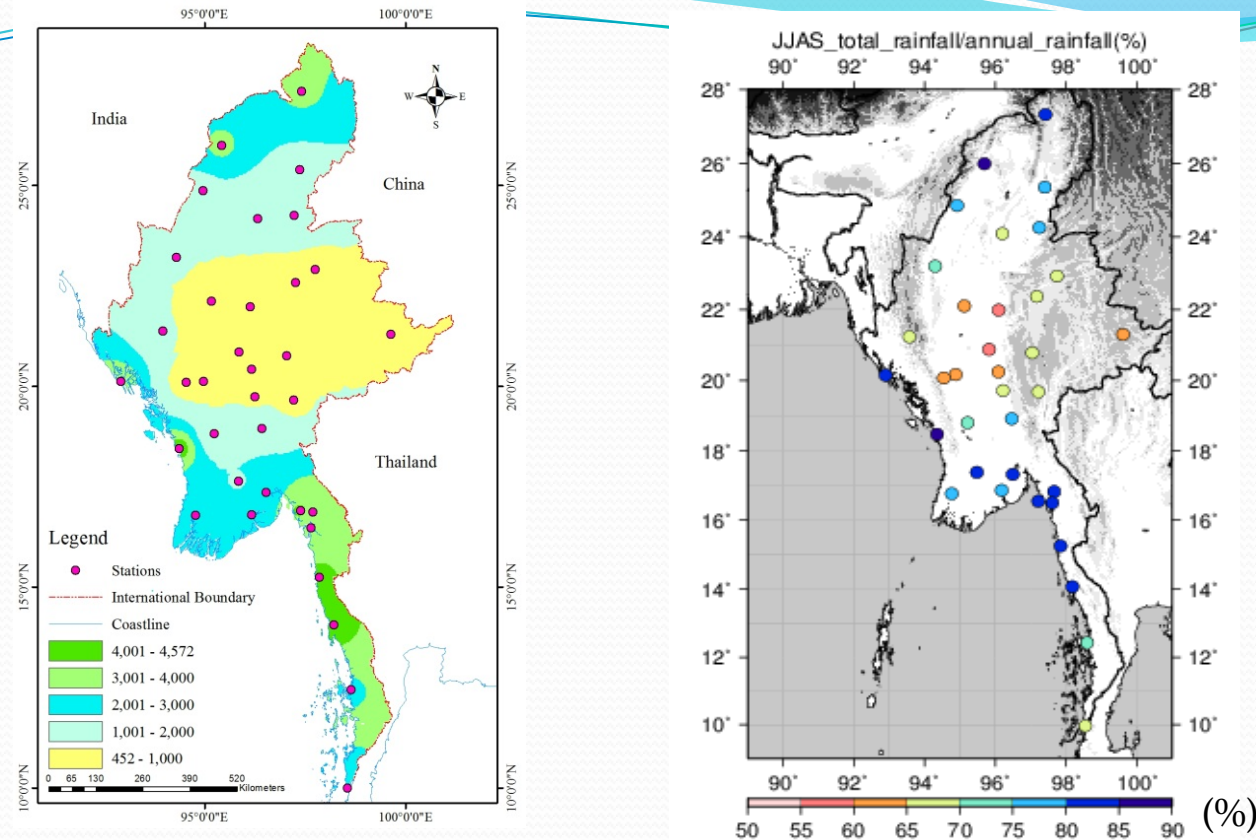


Figure 6. Distribution of JJAS seasonal mean rainfall ( left) and its percentage to annual mean over Myanmar from (1971-2000) (right).

- According to above Figures the total rainfall accumulated within this monsoon period accounts for 85 to 90% of total annual rainfall for most of the country especially for the coastal areas.
- The stations located in northern , southern part of Myanmar and west coast has highest rainfall amount (3000-4500) mm (80-90%). However, the central part of Myanmar has lowest rainfall amount (450-1000) mm (60-65) % in rainy season.

## 4. Analysis and results

### The Cluster analysis

#### The dendrogram of the cluster analysis

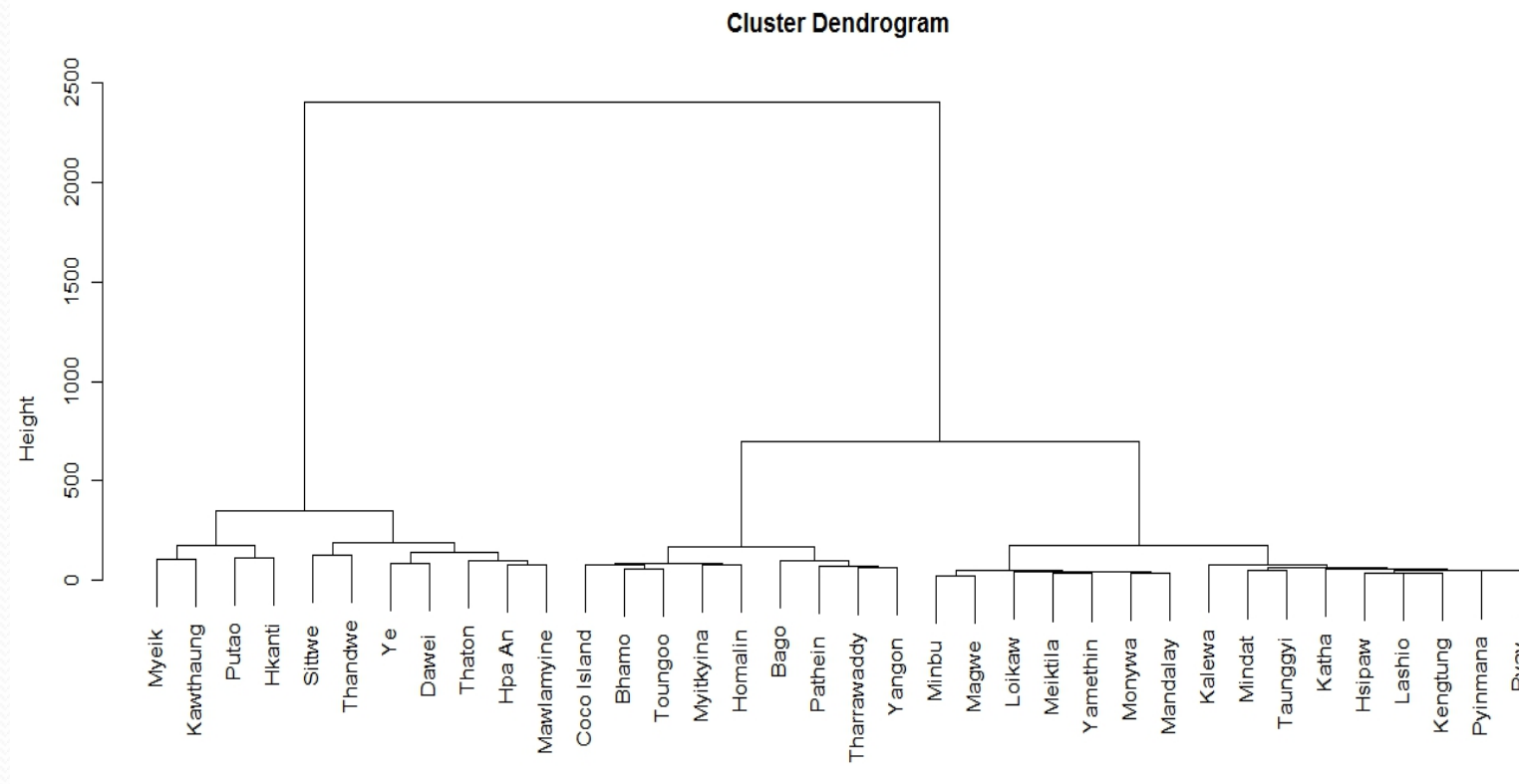


Figure 7. The dendrogram of the cluster analysis

The cluster analysis based on Ward's method was applied for the seasonal variation patterns of daily mean precipitation data.

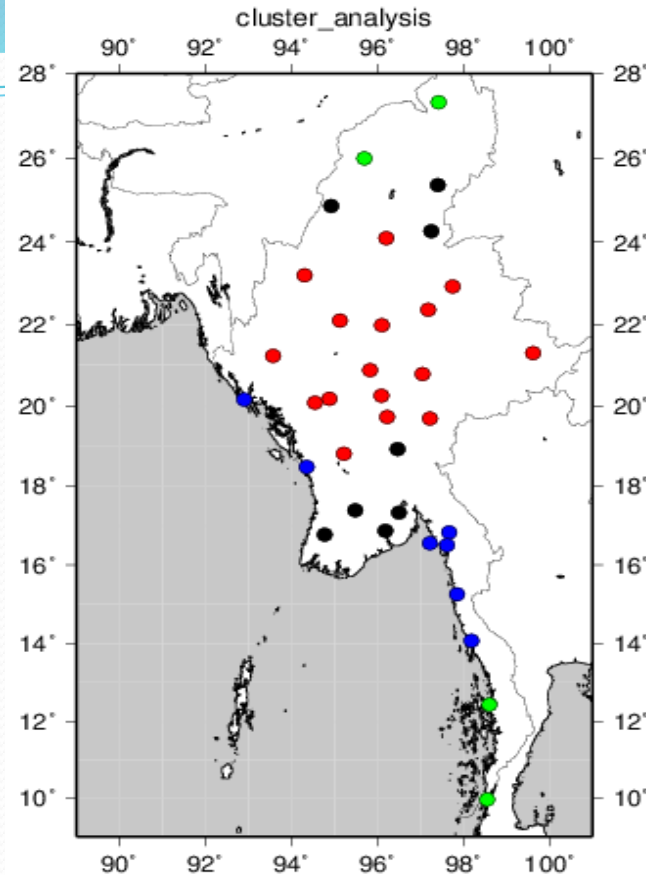


Figure 8 .The regional division of rainfall stations based on seasonal March of daily mean precipitation (dividing 35 stations into 4 groups)

The 35 rainfall stations dividing into 4 groups. Four types of rainfall pattern were identified. There are 4 stations in **Group 1**, 8 stations in **Group 2** , 16 stations station in **Group 3** and 7 stations in **Group 4**.

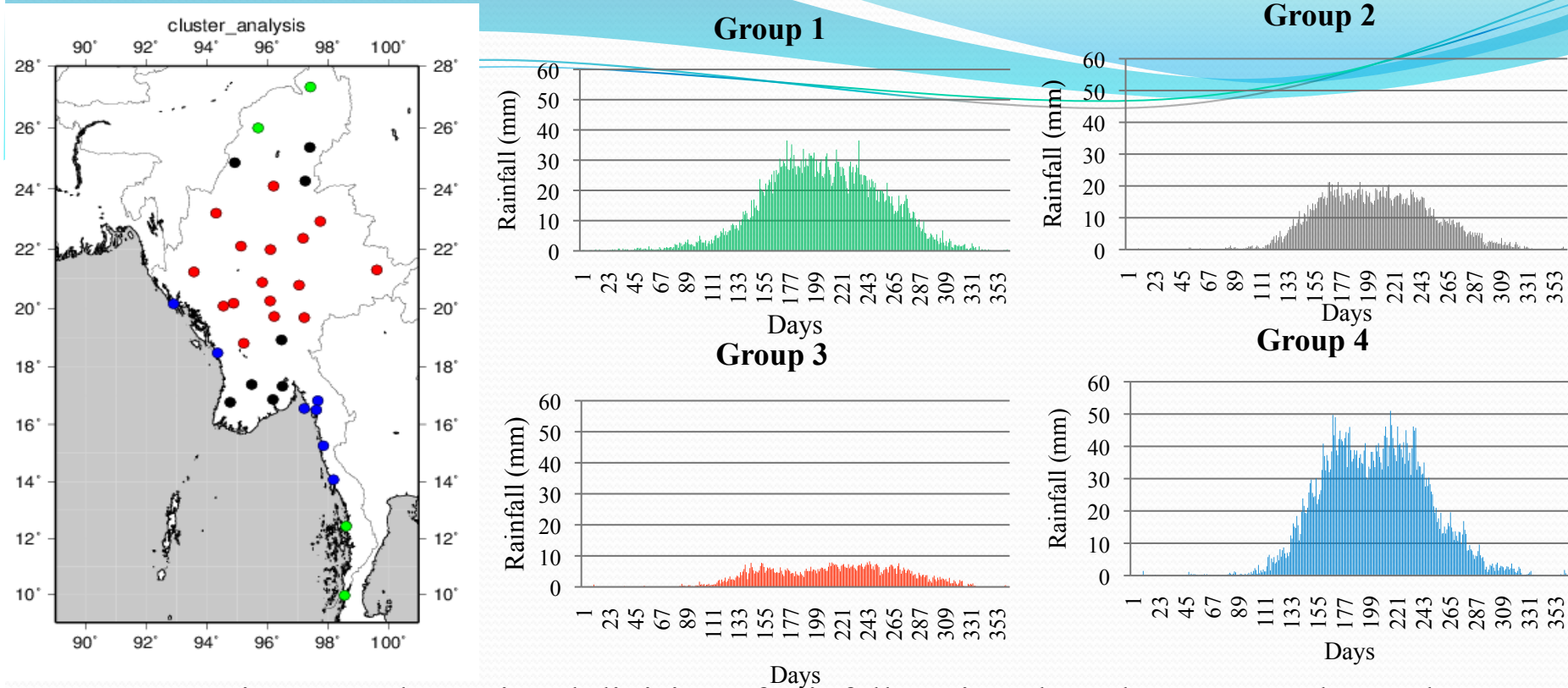



Figure 8. The regional division of rainfall stations based on seasonal March daily mean precipitation (dividing 35 stations into 4 groups) by Ward's method

Coastal Region is the most significant rainfall zone and highest peak during monsoon season because of near BOB and Andaman Sea. (Group 4). The southernmost part and northernmost part are also comparatively heavy rainfall. (Group 1). The Central region is relatively less rainfall area. (Group 3).



## **II. Influence of ENSO on the summer monsoon precipitation over Myanmar.**





Table 1. Developing and Decaying years of El Niño and La Niña events . All ENSO events defined in this study are included within the definition of Trenberth (1997).

| El Nino    |          | La Nina    |          |
|------------|----------|------------|----------|
| Developing | Decaying | Developing | Decaying |
| 1972       | 1973     | -          | 1971     |
| 1982       | 1983     | 1973       | 1974     |
| 1986       | 1987     | 1975       | 1976     |
| 1991       | 1992     | 1984       | 1985     |
| 1994       | 1995     | 1988       | 1989     |
| 1997       | 1998     | 1998       | 2000     |

An ENSO developing year is defined as the year before the mature phase of ENSO and an ENSO decaying year is defined as the year after the mature phase of ENSO. The labels of years follow the notation of Rasmusson and Carpenter (1982). The Nino-3.4 (5°N–5°S, 170°–120°W) SST anomalies are used as an ENSO index. A mature phase of the warm event of ENSO (El Niño) is defined when the ENSO index averaged over winter is larger than 0.9C and a mature phase of the cold event of ENSO (La Niña) is defined when the ENSO index averaged over the same period is less than -0.9C.

# Rainfall percentage departure for El Niño developing years.

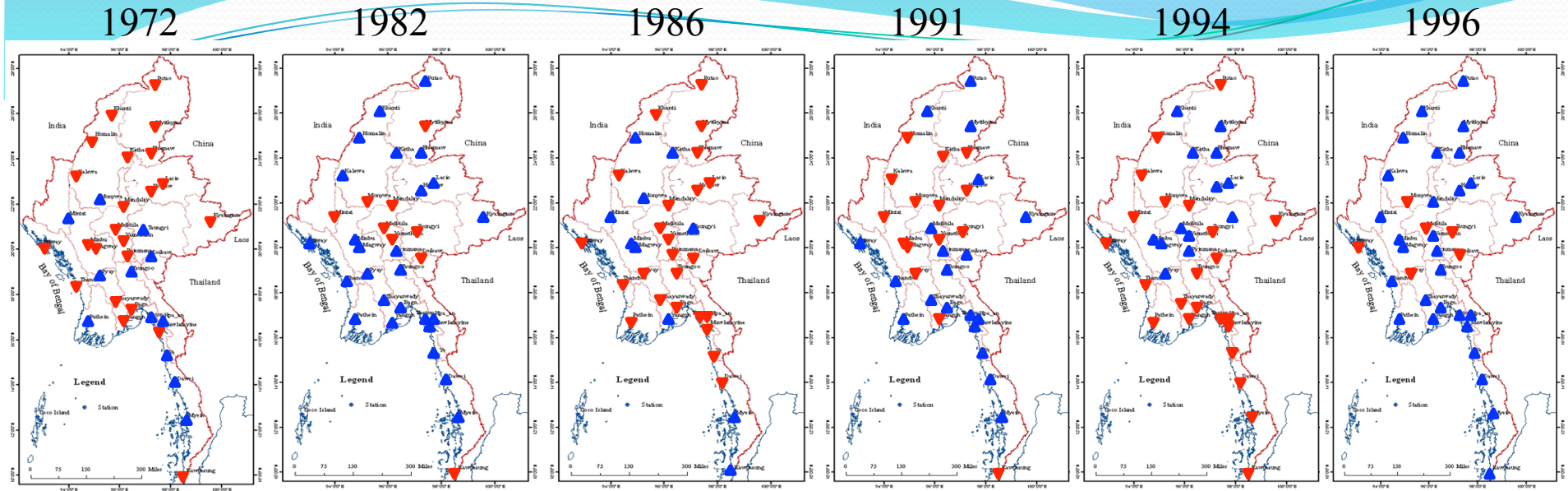


Figure 9. Distribution of JJAS rainfall percentage departure for El Niño developing years.

| El Niño developing years | ▲ excess rainfall (no: of station) | ▼ below rainfall (no: of station) | Rf% Dep for whole country |
|--------------------------|------------------------------------|-----------------------------------|---------------------------|
| 1972                     | 12                                 | 23                                | -12%                      |
| 1982                     | 26                                 | 9                                 | 5%                        |
| 1986                     | 10                                 | 25                                | -17%                      |
| 1991                     | 20                                 | 15                                | 15%                       |
| 1994                     | 13                                 | 22                                | -32%                      |
| 1996                     | 29                                 | 6                                 | 20%                       |

## Rainfall percentage departure for El Nino decaying years.

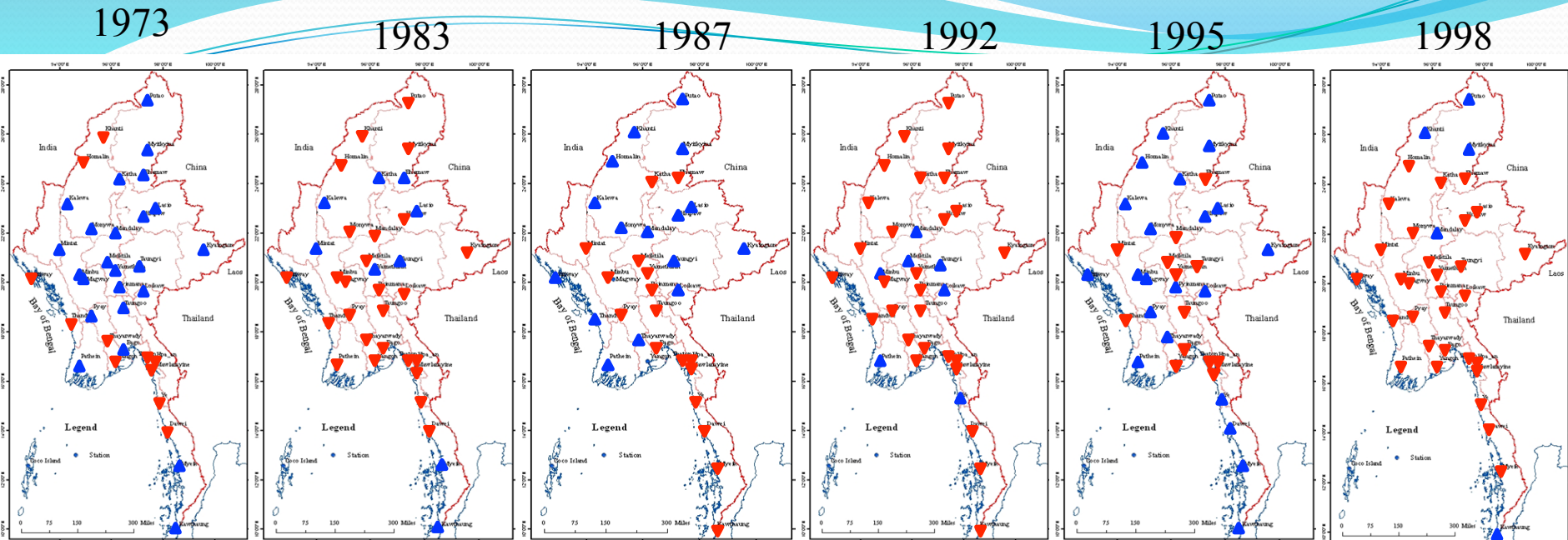


Figure 10. Distribution of JJAS rainfall percentage departure of El Niño decaying years.

| El Niño<br>decaying years | ▲ excess rainfall<br>(no: of station) | ▼ below rainfall<br>(no: of station) | Rf% Dep for whole<br>country |
|---------------------------|---------------------------------------|--------------------------------------|------------------------------|
| 1973                      | 24                                    | 11                                   | 28%                          |
| 1983                      | 9                                     | 26                                   | -80%                         |
| 1987                      | 18                                    | 17                                   | -17%                         |
| 1992                      | 7                                     | 28                                   | -52%                         |
| 1995                      | 22                                    | 13                                   | -25%                         |
| 1998                      | 5                                     | 30                                   | -78%                         |

## Rainfall percentage departure for La Niña developing years.

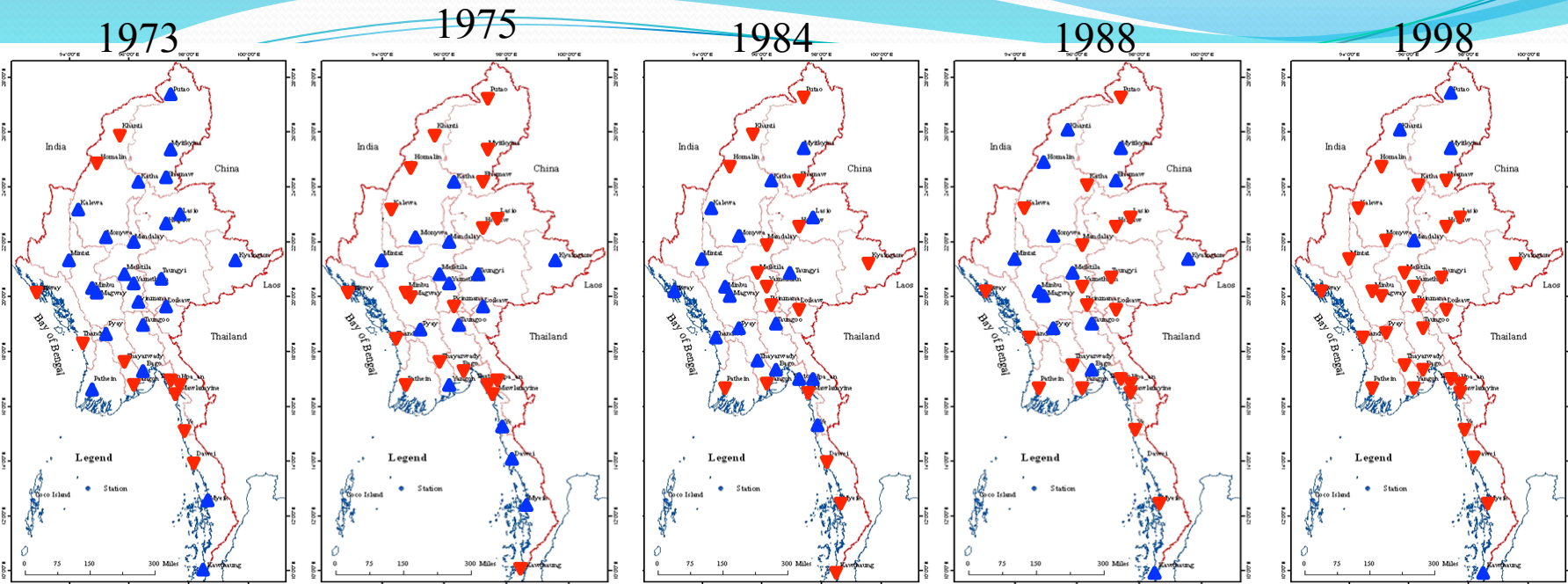


Figure 11. Distribution of JJAS rainfall percentage departure of La Niña developing years.

| La Niña developing years | ▲ excess rainfall (no: of station) | ▼ below rainfall (no: of station) | Rf% Dep for whole country |
|--------------------------|------------------------------------|-----------------------------------|---------------------------|
| 1973                     | 24                                 | 11                                | 28%                       |
| 1975                     | 15                                 | 20                                | 7%                        |
| 1984                     | 17                                 | 18                                | -4%                       |
| 1988                     | 15                                 | 20                                | -16%                      |
| 1998                     | 5                                  | 30                                | -78%                      |

## Rainfall percentage departure for La Niña decaying years.

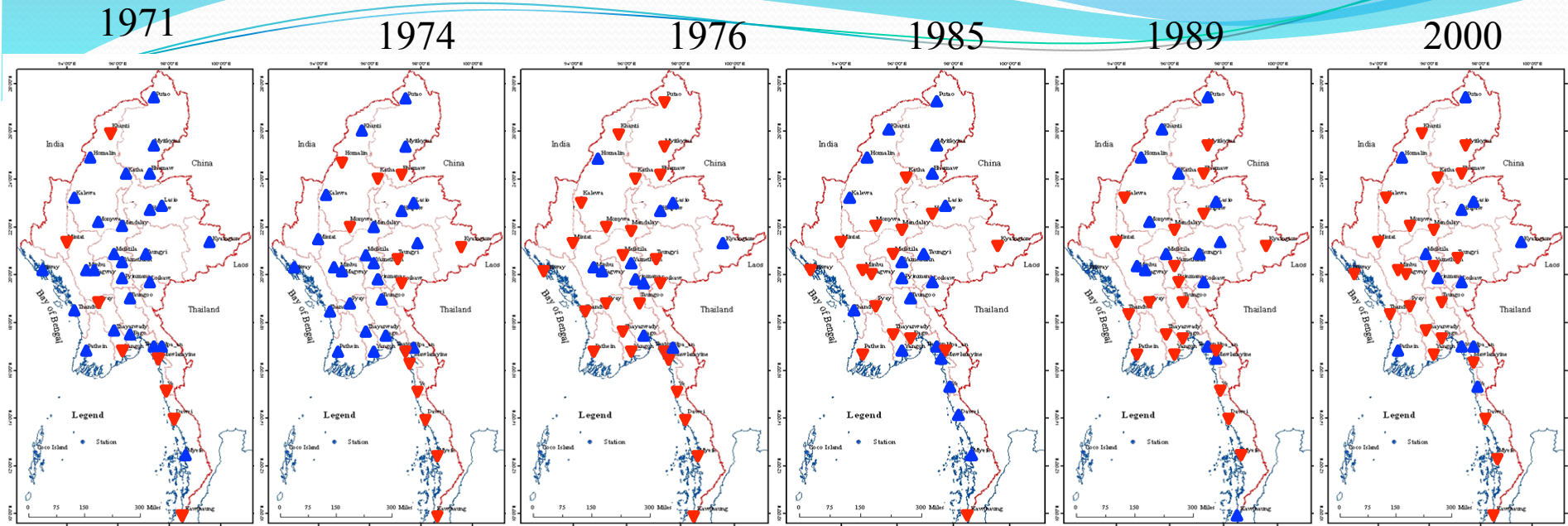


Figure 12. Distribution of JJAS rainfall percentage departure of La Niña decaying years.

| La Niña<br>decaying years | ▲ excess rainfall<br>(no: of station) | ▼ below rainfall<br>(no: of station) | Rf% Dep for whole<br>country |
|---------------------------|---------------------------------------|--------------------------------------|------------------------------|
| 1971                      | 27                                    | 8                                    | 45%                          |
| 1974                      | 23                                    | 12                                   | 12%                          |
| 1976                      | 11                                    | 24                                   | -21%                         |
| 1985                      | 19                                    | 16                                   | 8%                           |
| 1989                      | 14                                    | 21                                   | -34%                         |
| 2000                      | 12                                    | 23                                   | -60%                         |



## 5. Discussion and conclusion

- During El Niño, La Niña developing and decaying years, both deficient and excess rainfall have been observed.
- So, ENSO does not have a one to one relationship with seasonal rainfall of Myanmar for El Niño developing year and La Niña developing and decaying years after 1970.
- To compare with India, also out of 17 El Niño years, between 1901 and 1996, only nine experienced deficient rainfall, while in other years, rainfall was either normal or excess, indicating that a weak correspondence between ENSO and seasonal rainfall (Pant and Kumar, 1997).

However,

All of the El Niño decaying years has deficient rainfall percentage departure except 1973 that is one of La Niña developing years. So, this is very interesting thing, ENSO is significantly influence over the seasonal rainfall of Myanmar especially in El Niño decaying years after 1970s to compare with the previous studies.

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Thank You very much for Your kind attention